Georgia Tech to Create Photonic Crystal Tools

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Photonic crystals, with highly periodic structures that can be designed to control light, have the potential to revolutionize everything from computing to communications. But researchers need more effective and affordable methods to create these promising crystals if they are going to find their way into personal computers or tiny sensors.

The Georgia Institute of Technology has been awarded a grant totaling $4.16 million for photonic and phononic (the photonic crystal's acoustic equivalent) crystal research by the Office of Naval Research (ONR). The grant also includes a two-year option for an additional $2.75 million. The new research group, led by Ali Adibi, an associate professor in Georgia Tech's School of Electrical and Computer Engineering, will develop very effective, yet relatively inexpensive tools for the manufacture of three-dimensional (3-D) photonic and phononic crystals.

While significant progress has been made in the large-scale fabrication of two-dimensional (2-D) photonic crystals, 3-D crystals are much more difficult to manufacture and the necessary tools are expensive. With extra dimensions of control, 3-D crystals produce effects that are impossible with conventional optics.

But because of the high cost of manufacturing tools, many researchers don't have the tools they need to experiment with different 3-D crystal structures and uses. The Georgia Tech group's goal is to develop new 3-D crystal fabrication tools affordable enough to make them accessible to a much wider range of researchers, stepping up crystal research and

increasing the possibility for innovation.

The new tools will be based on optical patterning of 3-D polymeric structures with chemical and biochemical modification to create high-quality photonic and phononic crystals with tailored functions and resolutions below 100 nanometers.

A portion of the group's research will focus on multiphoton lithography (MPL) and multibeam interference lithography (MBIL). These polymer micropatterning methods show great potential for efficient and low-cost creation of 3-D microstructures. Other research focus areas include the development of an expanded range of materials for computer structures, the development of tools that integrate the characteristics of biomaterialization (room temperature, chemically selective nanoparticle assembly) with those of synthetic polymer microlithography (precise scalable fabrication of controlled 2-D and 3-D structures), and simulation and characterization tools to test the strengths and weaknesses of each tool.

Key collaborators on the project, called APEX (Advanced Processing-tools for Electromagnetic/acoustic Xtals or crystals), include Joseph Perry and Seth Marder, professors in Georgia Tech's School of Chemistry and Biochemistry and Kenneth Sandhage, professor in Georgia Tech's School of Materials Science and Engineering. Other research collaborators include William Hunt, a professor in Georgia Tech's School of Electrical and Computer Engineering; Nils Kröger, an assistant professor of Chemistry; Robert Norwood and Nasser Peyghambarian from the University of Arizona; and Shu Yang from the University of Pennsylvania.

"I consider this the beginning of a great effort to expand our group into one of the most well-known centers for photonic crystal research," Adibi said.

Source: Georgia Institute of Technology

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